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SMART BUS STOPS

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Abstract

The importance of well-organized and set bus stops at appropriate locations is of great importance for the city. Cities are striving to provide a quality lifestyle for their residents and to become smarter and more fit. Passenger terminals, as an important segment of the transportation system, must be integrated into the concept of a smart city. In recent years, there have been various initiatives to improve public spaces such as bus stops with the aim of providing quality customer service. The application of modern technologies makes it possible for viewpoints to become smart and to make waiting times for public transport vehicles a useful activity.

1. INTRODUCTION

The more decades-long trend of moving population from smaller communities to cities is still present. There are several reasons for population migration to cities, such as, for example, rural underdevelopment, greater opportunities offered by cities in terms of education, employment and generally quality of social life. Due to the increasing of population, cities are trying to adequately adapt to the changes that have occurred and to organize the housing, movement and functioning of the population in general as effectively as possible. The population migrations continue and do not tend to change in the form of shrinking urban populations, and it is a reason that city governments will need to work even harder and more efficiently. As a result, various "smart strategies" that are implemented in different fields are becoming increasingly important, so that smart cities will set standards in major metropolitan areas around the world in the near future.

2. SMART CITIES AND IOT (INTERNET OF THINGS)

The term IoT is networking of objects over the internet. Different networked objects are intended to provide support for people in their everyday lives and at the same time generate an enormous amount of structured data, which can be used for analyses and optimisations [1]. The essence is that the smart city takes into account all the basic elements that make up the urban tissue, in order to avoid conflicts (social, economic, financial, environmental and cultural), with the aim of improving the environment and quality of life in general.

The smart cities are using IoT devices, as sensors, lights and counter for collect and analyze data [2]. Therefore, IoT is considered to be one of the most important data providers. The collected data is used later to improve infrastructure, various utilities, etc. Smart cities provide a more efficient and quality lifestyle for their residents. Although there is no clear definition of "smart city", the goal for smart city initiatives is usually aimed at implementing seamless integration of communications infrastructure, sensor and mobile technologies. They are using applications that provide access to a variety of public services for citizens. Cities in North America and Europe are leading the effort in implementing smart technologies to address urban issues such as traffic jams and high energy costs, using opportunities such as the use of solar energy in street lighting, smart traffic lights at intersections, smart buildings, smart bus stops, etc.

3. BUS STOPS AND SMART TECHNOLOGIES

The smart bus stop is an urban instalation who can offer real time information by establishing linkages with buses through GPS tracking and RFID tags. LED displays at bus stops display different data as bus number of arriving buses, arriving times for buses, buses routes, etc. More developed systems can even display the available seats on the next bus. The smart bus stop actually improves the bus travel experience because its ability to communicate with users through the bus route guide, displaying digital maps, searching for destinations, viewing weather forecasts, etc. Interactive touch screens in the bus shelter function as city dashboard and act as an interface of city with the users. It makes waiting for a bus no longer cumbersome or unreliable, but rather a fun activity [3].

The IoT is an integral part of the concept of smart cities and has widely used, which has found its place within bus stops also. With new IoT technologies, bus stops have the potential to improve, providing a better experience for passengers as well as creating value for companies and public transport providers. The integration of the IoT on buses enhances the way information is presented to the public by displays. Information in focus includes digital advertising, public announcements, or other information regarding significant events. The location and time of presented information are key factors under consideration, in order to effectively convey relevant information to the target audience. Moreover, the use of sensors can generate data analytics that describe the traffic flow by city carriers, providing useful information for public transport service providers. Different scenarios are being considered, whereby smart bus stops can be useful. Small

scale prototype has been developed to illustrate the proof of concept for the proposed solution. The prototype demonstrates dynamic social media advertising and demonstrates the prediction of daily migrations from sensory data. In addition, prototype testing is conducted to evaluate its functionality. Other benefits, such as reducing energy consumption of devices such as lights, screens and smart heating systems for bus stops, are being considered.

An example of a smart bus stop is shown in Figure 1.

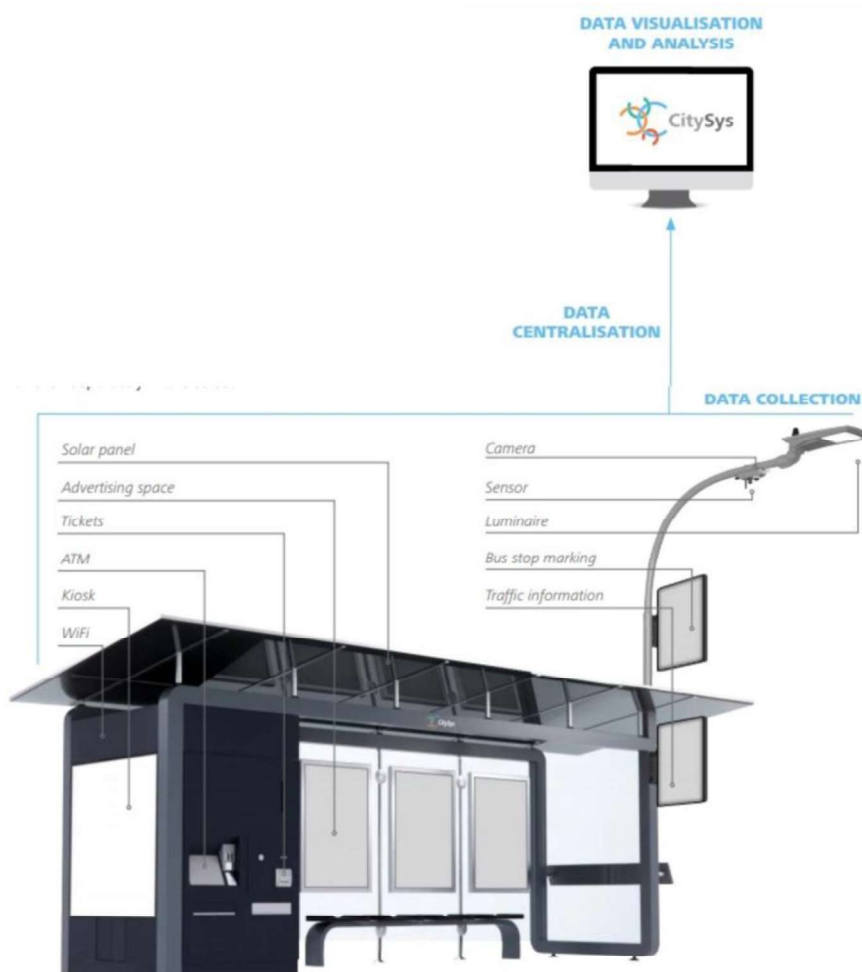


Figure 1. Smart bus stop [4]

The bus stop from Figure 1 offers many integrated functions, such as the sale of public transport tickets via integrated payment devices, locking of bicycles, sale of food and beverages, monitoring of air quality and noise levels, security camera, heated benches and seats, Wi-Fi connection, advertising space and accessibility of various information via Smart Kiosk. All the information and services are easily

accessible even for children and disabled people. Stereo speakers enable easy access to necessary information even for visually impaired citizens. Smart Kiosk integrated in the bus stop offers an additional vast amount of information available for citizens. The interactive Kiosk is a computer terminal providing access to information and applications for communication, commerce, entertainment or education [4].

Generally speaking, smart bus stops can make a significant contribution to improving the services offered to customers. Travel is very easy for all travelers. The opportunity to find significant tourist attractions and sites can be offered tourists in major cities. all the important city news and current events could be relayed to citizens. On the other hand, one should not forget the fact that bus stops are located at all strategically important locations in the city. Because of this, bus stops are important for different advertisers. On this way the advertisements are accessible to all public transport users, pedestrians and even drivers passing next to bus stops by their vehicles. New methods of interactive advertising are becoming more current and renting ownership to bus companies is becoming more common.

3.1. Smart bus stops in Serbia

The application of smart bus stops is only beginning in Serbia. Some cities were given the first smart bus stops, with a tendency to increase their numbers. There is a Petro-mont company from Novi Sad, that manufactures smart bus stops.

PetroSOLAR bus stops are smart bus stops, which increase traffic safety and increase passenger care. Each bus stop is energy independent because it is powered by solar energy entirely and have the following elements integrated in the basic variant: solar cell with battery, standalone LED lighting, free chargers for mobile devices and WiFi routers for wireless internet. These bus stops can integrate many additional elements, in addition to the basic elements, such as: LED displays, interactive monitors or billboards, roto and print advertisements, etc [5].

There is possibility for a special upgrade for these bus stops. The bus stops can to be networked in a unique city BUS STOP system, which is able to monitor and provide information on bus routes, expected bus arrival times, or information on air quality, temperature , humidity. As an option, it is possible to install kinetic floorboards that generate electricity from pedestrian walkways. Each smart stand is powered solely by solar energy and does not require any additional wiring to function, and it is ideal and cost-effective solution for installation in numerous off-site and inter-city locations [5].



Figure 2. Smart bus stop in municipality Voždovac, Belgrade [6]

4. CONCLUSION

Bus stops, as an important segment of the transportation system, must be integrated into the concept of a smart city. This is primarily intended to enable the use of smart technologies to enable real-time data collection, which is analyzed and forwarded to passengers, the public transport management center, drivers, etc. This means that bus stops should be a source of innovation, adjusted to local specifics, which can add value and turn them into an example of a successful business model. In the context of a smart community, bus stops equipped with smart technologies can revive, enhance customer experiences and open up new business opportunities.

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